

ELECTROLYSIS IN THE TREATMENT OF FIBROUS ANCHYLOSIS.

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IF one may judge by the small amount of literature presented, electricity seems still to be employed in surgery only by the gynæcologist as a means of reducing fibroid tumors, fibrous adhesions, and other conditions in this special branch, and by surgeons for diagnostic and cautery work, for traumatic paralyses, and, perhaps, by a few in the treatment of strictures of the urethra and rectum and some other conditions; but none seem to have made use of it, except incidentally, in the treatment of restriction of motion in joints, tendons and muscles, due to the development of new-formed fibrous tissue following traumatism, whether accidental or operative, and disease.

In "An American Text-Book of Surgery" (page 404) the author says: "By massage, by frictions, by baths, by regulated movements, by the use of electricity, especially by massage and movements, much may be accomplished in the removal of peri-articular exudations and adhesions. But in the majority of cases a fibrous ankylosis will require for its removal either a forcible rapid breaking up of the adhesions and straightening of the limb or a slowly-effected correction of the deformity by continuous or intermittent traction, by weight-extension, or by apparatus. As a rule, the former method is to be preferred. . . . The operation is usually free from danger, and followed by little or no local or constitutional disturbance. But accidents, and serious ones, may occur. . . . No one of these accidents is to be expected; any one of them may happen. Because of the setting free of

the infecting organisms . . . forcible breaking up of ankylosis following either septic or tubercular disease should not be done. By the employment of weight-extension, or by an apparatus permitting of a gradual widening of the abnormal angle, the deformity can usually be corrected after a time." In another paragraph: "Both at the elbow and at the knee (after fracture of the patella) a resulting fibrous ankylosis, if forcibly broken up, will commonly be quickly reproduced, but with active use of the joint will generally spontaneously disappear in the course of a few months, or, at most, in a year or two."

I have quoted at some length because, this being our latest text-book and by eminent authors, it may be considered a standard of what we think and teach at the present day, and I find by comparison that it agrees substantially with the latest German works. If, then, the above is accepted as a standard of our treatment, it certainly leaves us very far from the ideal, and it is simply allowing nature to effect a cure with very little help from us.

As for the forcible breaking up of adhesions, we have all had the experience of the author, and while in a few cases we succeed, in a majority the result is, as the author says, a prompt return of the condition.

Massage, passive motion and baths are no doubt of great help, but they are only adjuncts to time and the continual use of the part.

Electricity is barely mentioned, and when it is employed is usually ordered as one would order a tonic or cathartic, the particular kind and quantity being left largely to the selection of the patient, nurse, or doctor.

The fact is established by numerous authorities that electricity is capable of dissolving new-formed fibrous tissue, but its use in the treatment of fibrous ankylosis seems never to have been systematically followed, or, at least, the results, so far as I know, have not been published. This may be for several reasons, of which the principal ones might be the amount of time necessary to its proper administration, and the annoyance the possession of the average battery causes by its general unsatis-

factoriness and unreliability. The first objection is not so great as it would appear, for the results are so quickly obtained that it becomes more a question of whether one gives the patient so many hours of time, divided into periods of half an hour for electricity, or shorter periods for manipulation, application and examination of apparatus, etc.; thus the question of time will be found in favor of electricity. The second assumed objection, I think, has been overcome, and I will consider it later.

It would be impossible for me in the time at my disposal to give even a faint outline of the known truths of electrolysis. That electricity has a dissolving action on newly-formed fibrous tissue is generally conceded, and any one doubting this should be convinced by referring to the literature of the past ten years. This electrolytic action is obtained with the galvanic current, either continuous, or what Dr. Piffard calls a fluctuating current. The mode of application briefly is as follows: I use electrodes varying in size according to the part under treatment and the extent of the adhesions; usually one large flat electrode and one ordinary sponge electrode with handle. The large one is easily made of thin sheet copper, and may be bent to any shape. It may be covered with sponge, cotton and sheet lint or other material, or placed without permanent covering in the dish of solution, a flat sponge or some cotton laid upon it and the part to be treated rested upon that, perhaps partly surrounded by the solution. The large electrode should be nearest the adhesions and attached to the negative pole; the small one applied to the opposite side.

Both electrodes should be wet in a salt solution, and of several solutions I have tried best, results have been obtained with a rather strong one of ammonium chloride.

The electrodes applied, the current is then turned on and increased till the patient will stand no more. The amount that can be given depends on the sensibility of the part and the temperament of the patient. If applied to the same part in two healthy individuals the amount borne by each will be found to vary very greatly. Passing a current through my own hand I can bear not more than 10 to 12 milliampères, while I have

given through the hand of another 50 milliampères with seemingly no greater discomfort.

The amount that a patient will take may be recorded from the milliamperé-meter at the first and second applications; and it will be found that the same or increased amounts may be given at future applications, except in some cases. Such a record will also be found useful in preventing any attempt at malingering.

As to the strength of current necessary to dissolve adhesions I can make no statement, except that I have obtained results with a current as low as 8 to 10, and have given as high as 75 milliampères, but have noticed no proportionate increase in the dissolution. I have remarked, however, that the older the adhesions the greater the current necessary to dissolve them, and believe in a strong current for a short time rather than a weak one for a longer time.

The duration of the applications I make from ten to thirty minutes, and repeat them at intervals varying from one to five days.

CASE I.—C. W., female, aged sixty-five years, housekeeper. Admitted to Bellevue Hospital November 21, 1892. Three months before fell from a low platform, striking on her right shoulder; swelling great and lasted four weeks; pain persisted to date of admission; had no professional treatment. Examination, November 21. No swelling, discoloration or deformity except that produced by slight atrophy of shoulder muscles; no tenderness on pressure; all motion at the shoulder is very much restricted. The hand is slightly swollen and bluish, showing poor circulation, and she is unable to use it except for coarsest kind of work. Complaints of continuous and increasing pain about the shoulder, down the arm and slightly in the fore-arm; it is now so great that it interferes with her rest at night.

November 25.—Galvanic current applied; directed through the shoulder.

November 29.—Reports having slept all the night following application, it being the first full night's rest since receipt of injury. Increased motion at shoulder, elbow and in hand.

The galvanic current was applied at intervals of from three to

five days with steady and rapid improvement in motion, and on December 8 the patient returned to her home in New Jersey, but came back for treatment at intervals till December 20.

The pain disappeared after the first application, and at the time she left me all motions at the shoulder were greatly increased, the hand had resumed its normal appearance and she was able to use it to dress and feed herself, and to do her housework with but little inconvenience.

Under date of May 18 Mrs. W. writes me that "There has been no return of the pain. I can raise my hand over my head and can place it back of me within two inches of as high above my waist as the well arm. I can now knit and sew and do all kinds of house work without inconvenience from arm or shoulder. The muscles have developed equal to those of the other arm."

CASE II.—M. C., female, aged forty-four, domestic. Admitted to Bellevue Hospital June 1, 1892. Tubercular (?) disease of right wrist joint, which was greatly swollen, very painful and filled with fluid. Treated vigorously until about July 15, when a plaster splint was applied.

The wrist was examined and the plaster reapplied at intervals until October 15, when it was found that the swelling and fluid had disappeared and pain was very much less. All the joints from the wrist down were ankylosed.

On October 20, under anæsthesia, the adhesions were broken up as much as possible; no motion whatever could be obtained at the metacarpo-phalangeal joints, and but slight motion at the others. This was followed by swelling and a return of the stiffness.

November 10.—The swelling had disappeared; there was very slight motion at the wrist, and none at the other joints. Hand and fingers were glazed, and circulation poor.

The galvanic current applied two and three times a week.

* December 17.—Thirteenth application. The wrist and fingers quite supple; about 35° motion at the metacarpo-phalangeal joints; the thumb can be carried to opposite the middle finger. The circulation is greatly improved, and she uses her hand actively to dress, eat and at work about the ward. Discharged from hospital at her own request.

CASE III.—J. B., male, age twenty-four, driver. On February 25, 1893, fell from the hub of a wheel to the ground, striking on left elbow. Treated for fracture of the external condyle at Bellevue Hospital.

April 11.—Patient referred to me. Examination showed fracture united; some effusion in, and fibrous thickening about, the joint. Rotation nearly normal; flexion and extension limited to

Angle of extension	136°
Angle of flexion	101°

Total motion	35°
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The galvanic current was applied every two days.

April 18 :

Angle of extension	145°
Angle of flexion	67°

Total motion	78°
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Gain, 43° (123 per cent.). Duration of treatment, seven days. The patient insisted on going to work, and appeared on April 30 with the elbow swollen, red and painful, having again fallen on it the night before. He states that the motion continued to increase until he received the second injury, and he had been able to do his work as coal shoveler.

On measurement his statement was verified, for, notwithstanding the swelling, he showed by active motion the following :

Angle of extension	118°
Angle of flexion	55°

Total motion	63°
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He was returned to Bellevue Hospital for treatment.

CASE IV.—M. D., female, aged forty-eight, domestic. On February 17, 1893, fell and received a Colles' fracture of the right wrist. Was treated at Bellevue Hospital with splints for four weeks, and carried wrist in sling two weeks longer. Since April 1 has been using it in work about the ward.

April 12.—Examination showed the hand swollen, with limited motion in the fingers; still less in the metacarpo-phalangeal joints. Had practically very little use of hand and wrist.

Flexion and extension at wrist	18°
Lateral motion at wrist	9°

Galvanic current applied.

April 19.—After fourth application :

Flexion and extension at wrist	53°
Lateral motion at wrist	25°

Circulation better; hand less swollen, and can use it much more.

April 28.—After seventh application :

Flexion and extension at wrist 60°

Lateral motion at wrist 32°

Circulation very much improved, and has such good use of her hand that she requested her discharge.

Gain in flexion and extension at wrist 42° (233%)

Gain in lateral motion at wrist 23° (255%)

Duration of treatment sixteen days.

CASE V.—J. W., male, aged twenty-six, sailor ; had syphilis six years ago ; never injured arm. Three years ago began to have pain in left elbow, which gradually became stiff ; eight months ago had to stop work because of pain and stiffness in the joint. Admitted to Bellevue Hospital December, 1892. Treated with anti-syphilitic remedies with no improvement.

February 13, 1893.—Dr. Woolsey operated and cleared the posterior olecranon fossa of a bony growth. The arm was dressed nearly straight ; the wound closed promptly.

March 27.—The patient was referred to me for electricity. Examination showed rotation very good :

Extension at elbow to 125°

Flexion at elbow to 115°

Total motion 10°

Galvanic current was applied.

April 7.—Applications were made at first every day ; then every other day to date. Examination shows :

Extension to 135°

Flexion to 90°

Total motion 45°

Gain 35° (350 per cent.). Duration of treatment ten days. Requested his discharge to resume work.

CASE VI.—W. T., male, aged nineteen, stableman, received an injury four years ago by being caught in machinery. The bones of the right forearm were found broken, and treated. The elbow received no treatment, and on recovery was ankylosed at a right angle ; pronation and supination were also absent.

March 18.—Dr. Woolsey operated, removing a bony union between the radius and ulna. The arm was put in plaster for two weeks, then dressed ordinarily.

May 15.—Pronation and supination very good:

Active extension at elbow to	143°
Active flexion at elbow to	128°
Total active flexion and extension	15°
Passive extension to	144°
Passive flexion to	119°
Total passive flexion and extension	25°

May 7.—Second application. Active and passive motion the same:

Extension to	148°
Flexion to	110°
Total flexion and extension	38°

May 13.—Fifth application:

Extension to	156°
Flexion to	94°
Total flexion and extension	62°

General circulation of extremity much improved.

Gain in flexion and extension 47° (313 per cent.) after five applications. Duration of treatment eight days.

Requested his discharge to go to work.

If the results in the foregoing cases be considered, it will be found that in

Case I the pain, which had persisted for three months, was relieved immediately; circulation in the hand restored; motion at the shoulder and general usefulness of upper extremity greatly increased. Duration of treatment twenty-five days.

Case II. The circulation improved; motion and usefulness of hand and wrist greatly increased. Duration of treatment thirty-seven days.

Case III. Gain in flexion and extension at elbow 42° (123 per cent.). Duration of treatment seven days.

Case IV. Circulation very much improved; motion and usefulness of fingers increased; gain of flexion and extension at wrist 42° (233 per cent.), in lateral motion 23° (255 per cent.) Duration of treatment sixteen days.

CASE V. Gain in flexion and extension at elbow 35° (350 per cent.). Duration of treatment ten days.

CASE VI. Circulation much improved; gain in flexion and extension at elbow 47° (313 per cent.) after five applications. Duration of treatment eight days.

Immediately after an application, using only a slight amount of force, the thinned and weakened adhesions could be felt to break. (I would here state that beyond this slight manipulation no passive motion was used in these cases.) It is also remarkable that there was an immediate and great increase of motion, in some cases it being doubled. With subsequent applications the increase became less and less pronounced, but in all cases there was a gain after each.

Judging from Cases II and III (the only ones I have been able to trace), I think it may be fairly assumed that any results obtained under this treatment can be considered permanent. This, with the rapidity of improvement, makes it, in my opinion, the most desirable and satisfactory of any treatment known to me.

In the cases given the adhesions were all of recent origin so I am not prepared to say from my own observation whether the galvanic current will dissolve old adhesions as readily. I have at present under my care a case of ankylosis of the elbow from injury of eight years' standing which has shown some improvement after three applications.

Regarding the second assumed objection to the use of electricity by surgeons, I think I can assert with confidence it no longer exists. Those who live on streets or avenues through which runs the Edison wires can be supplied with the street current, which may be safely and conveniently used by means of instruments devised by Dr. H. G. Piffard. This current is very serviceable, but not cheap.

Those who, like myself, cannot obtain the Edison current, must have house batteries. I have several, which have only brought me disappointment until I obtained my present one, made by the Edison Manufacturing Company of this city. Their battery is composed of zinc and copper oxide plates in a potash solution, and possesses the following advantages over all others I

have used: The elements are left in the solution continuously, there being only 1 per cent. per month of action except when the circuit is closed. The current is very steady, so that the use of a storage battery is unnecessary for lighting diagnostic lamps; this uniformity continues to the end of the life of the battery. In other wet-cell batteries that I have used the current is very unsteady, and begins to decrease within a few minutes, sometimes going to almost nothing, due to polarization of the elements.

The battery requires no care until exhausted, when all except the jar and frame is renewed, making practically a new battery.

The life of the cells is known, and they may be had of different sizes. Their life in one's office will depend on the amount of electricity used, plus a wear and tear of 1 per cent. per month.

I have given my battery four months' hard usage, and recent tests show the same voltage and amperage as when first set up. The cells are nine-tenth volts each, but the internal resistance is so low that the amperage is very much higher in proportion than some other cells of greater voltage; but, of course, a larger number of cells is required than those of one and a half to two volts each. My battery consists of fifty-four cells placed in a closet off my office, and connected with the switch-board by cable. With this I can do any kind of electric work that a physician or surgeon requires. I have at my disposal all the current necessary for galvanic, faradic, cautery, lighting and motor work. The switch-board may be as simple or as elaborate as one pleases; mine is very elaborate, and with it I can get all the variations of the galvanic and faradic currents of which I have knowledge.